PROBABILITY AND STATISTICS. RESEARCH TOPIC: STOCHASTIC PROCESSES AND THEIR INFERENCE.

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ABSTRACT. The first passage time density of a diffusion process to a time varying threshold is of primary interest in different fields. Here, we consider a Brownian motion in presence of an exponentially decaying threshold to model the neuronal spiking activity. Since analytical expressions of the first passage time density are not available, we propose to approximate the curved boundary by means of a continuous two-piecewise linear threshold. Explicit expressions for the first passage time density towards the new boundary are provided. First, we introduce different approximating linear threshold. Then, we describe how to choose the optimal one minimizing the distance to the curved boundary, and hence the error in the corresponding passage time density. Theoretical means, variances and coefficients of variation given by our method are compared with empirical quantities from simulated data. Moreover, a further comparison with firing statistics derived under the assumption of a small amplitude of the time- dependent change in the threshold, is also carried out. Finally, maximum likelihood and moment estimators of the parameters of the model are calculated and applied on simulated data.

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